
APPENDIX E.1

Aquatic Macroinvertebrate Biotic Field Surveys and Taxonomy – 1999 Results

Submitted by Kurt L. Schmude, Ph.D., Lake Superior Research Institute, November 30, 1999

Introduction

The Wisconsin Department of Natural Resources (WDNR) initiated a broad-based inventory (flora, fauna, and natural communities) of the Wolf River GMU in 1999. This inventory project will support the state master planning process by providing information to public agency administrators, planners, and managers and aiding the prioritization of sites and species for protection by public and private conservation organizations. Field inventory of aquatic macroinvertebrates is essential for managing and protecting natural resources and thus an important component in the biotic inventory process. Many aquatic macroinvertebrates are sensitive indicators of habitat quality and land use.

The inventories will allow biologists and planners to understand the distribution and relative abundance of some of the most important aquatic species and communities, and to select the most appropriate sites for conserving rare taxa and intact natural communities. The information will also be used for comparing biota of manipulated versus natural systems. Several potentially rare aquatic insects are known, suspected, or have a high probability of occurring within the project area. Because no systematic search for them has occurred, WDNR is presently unable to assign status or conservation priority to many of these species with confidence.

A total of 76 sites within the lower Wolf River Watershed were sampled for aquatic macroinvertebrates. Sites were located in Outagamie, Shawano, Waupaca, and Winnebago counties. Sampling occurred on May 21, and from June 2 through June 9, 1999. Sampling was performed by Dr. Kurt Schmude and three student assistants (Chris Brennan, Jason Tanck, Andrea Anderson).

Methods

Lotic Sites

A total of 56 lotic sites were sampled. At each site, the available habitats were determined and each person was responsible for a particular habitat(s). Sampling was performed using a D-frame aquatic net (approx. 1 mm mesh). The kick-sampling method was used in riffles and runs, while undercut banks were sampled by rigorously manipulating the net in the undercut substrates. Sample debris was placed on a large mesh screen over a large plastic tray and the organisms fell through the mesh into the tray. Sample debris was then searched for cryptic, slow-moving organisms; all specimens were preserved in plastic vials containing 70% ethanol. Submerged structures (wood, rocks) were taken out of the water and inspected, and other habitats (water surface, shoreline) were visually inspected for organisms and exuviae. Habitats that were sampled included the following:

- A. rocky riffles and runs
- B. submerged wood and roots
- C. undercut banks
- D. submerged and emergent vegetation

- E. sandy, silty, and/or clayey runs near the shoreline
- F. shallow and deep sand bars and sand bar drop-offs
- G. surface (surface-dwelling organisms)
- H. shorelines and bridges (exuviae)

Lentic Sites

A total of 20 lentic sites were sampled. The available habitats were again determined and each person was responsible for a particular habitat(s) or area(s) to sample. The same methods were employed. Habitats that were sampled included the following:

- A. shallow, vegetated areas
- B. water column of deeper areas
- C. submerged wood
- D. shallow sandy/silty areas near the shoreline
- E. surface
- F. shoreline searches for exuviae

In addition, the sites listed below were sampled using submerged bottle traps. Two traps were placed in shallow, vegetated areas. The traps were deployed from June 7 to June 9, approximately 48 hours. The sites were chosen by James Robaidek (WI DNR), who provided assistance in locating each site on each day. The sites represented a wide range of habitats over a large area within the Wolf River GMU. Each site was located on state-owned property. Many of the sites were actively being managed, and Mr. Robaidek thought it would be valuable to obtain biotic information on these sites.

- A. Hortonville Bog (SCH99-101)
- B. flowages on LaSage Property (SCH99-103)
- C. Shioc Mitigation Site (SCH99-104)
- D. Maine Wildlife Area (marsh/swamp) (SCH99-105)
- E. Maine Wildlife Area (bog) (SCH99-106)
- F. bog in Navarino State Wildlife Area (SCH99-107)
- G. Pikes Peak Flowage (marsh) (SCH99-108)
- H. McDonald Flowage (marsh) (SCH99-110)

Sampling Problems

Sampling deep portions of large streams for benthic macroinvertebrates has always been difficult or impossible, even with specialized equipment. Some segments of the Wolf and Embarrass Rivers were not sampled for these reasons. Another problem was the timing of this study did not allow sampling during the most productive periods for some insect groups such as winter stoneflies, spring caddisflies, or summer and fall bugs and beetles. Finally, many fast moving lentic species are difficult to sample with standard nets and collecting techniques

Remedies

Sample the above rivers and sites with a boat, and use dredges or other deep-water sampling equipment. For dragonflies properly timed shoreline exuvia searches were conducted adjacent to deep water segments. Unfortunately most other groups are not detectable with method. Also, sampling would likely have been more productive in terms of abundance and diversity if the timing of the trips took place in early to late May. Sampling the sites at different times of the year would allow detection of aquatic insects that were low in numbers or absent during the study period.

Results

The table below lists each site, the minimum number of taxa identified at each site, the habitats sampled, the number of new county records, and pertinent notes on the sampling effort or identification of the site. Sites are grouped into the following major categories:

- A. Large rivers
- B. Small to medium-sized rivers
- C. Flowages
- D. Shallow marshes
- E. Swamps
- F. Bogs
- G. Springs
- H. Sloughs
- I. Lakes

Taxa were identified to the lowest taxonomic level possible based on current literature and the expertise of the participating taxonomists (Dr. Kurt Schmude - all macroinvertebrates, Mr. William Smith - odonates, Dr. William Hilsenhoff - consultant). In some cases, specimens were identified to a higher taxonomic level due to the lack of a key to species, even though two or more species were clearly recognizable among the specimens; sites where this situation occurred are marked with a plus (+). Seven sites were sampled with both nets and submerged bottle traps. The number of taxa collected by each method is listed, along with the total number of different taxa collected by both methods.

Habitat codes are as follows: A=riffle, B=run, C=pool, D=lake, E=bank.

New county records were determined based on published scientific literature, and previous DNR survey studies of macroinvertebrates performed by the author. Many groups of aquatic macroinvertebrates have not been intensively studied at the species level, and detailed data on their distribution in Wisconsin is not available. Data for the following taxa were available for the determination of new county records:

1. all Heteroptera (aquatic and semi-aquatic bugs)
2. almost all aquatic Coleoptera (beetles, except Chrysomelidae, Curculionidae, Scirtidae)
3. Baetiscidae, Heptageniidae, Pseudironidae (mayflies)
4. Perlodidae (stoneflies)
5. Hydropsychidae, Brachycentridae (caddisflies)

Sampling effort was restricted at some sites due to the difficult and/or dangerous conditions at the site.

<u>Site</u>	<u># Taxa</u>	<u>Habitat</u>	<u>New County Records</u>	<u>Notes</u>
<u>LARGE RIVERS</u>				
Wolf River (18 sites)				
SCH99-053	80	B,E	6	
SCH99-055	55	B,E	3	
SCH99-058	16	B,E	1	
SCH99-059	25	B,E	1	
SCH99-060	54+	B,E	2	
SCH99-063	8	B	1	restricted sampling
SCH99-066	12	B,E		restricted sampling

<u>Site</u>	<u># Taxa</u>	<u>Habitat</u>	<u>New County Records</u>	<u>Notes</u>
SCH99-067	2	only wood		restricted sampling
SCH99-068	4	E		very restricted sampling
SCH99-069	9	B,E		restricted sampling
SCH99-077	39	B,E	3	
SCH99-078	18	B,E	2	
SCH99-079	24	B,E	2	
SCH99-084	15+	E		restricted sampling
SCH99-085	28	B,E	1	
SCH99-097	29	B,E	3	
SCH99-098	30+	B		
SCH99-128	29+	B,E	1	
Little Wolf River (6 sites)				
SCH99-080	61	A,B,E	2	
SCH99-091	40	B,E		
SCH99-092	35	B,E	2	
SCH99-093	34+	A,B,E	2	
SCH99-094	42	A,B,E		
SCH99-126	45	A		
South Branch Little Wolf River				
SCH99-089	38	B,E	3	
SCH99-090	36+	B,E	1	
Embarrass River (10 sites)				
SCH99-096	44+	B,E	1	
SCH99-100	32	B,E	1	
SCH99-117	40+	B,E	2	
SCH99-118	9	B,E	2	restricted sampling
SCH99-119	24+	B,E	1	
SCH99-120	18+	B	2	
SCH99-121	12+	B	2	
SCH99-122	12	B,E		
SCH99-124	19+	B	1	
SCH99-125	22	B,E		
Waupaca River				
SCH99-082	36	B,E		
SCH99-088	40+	B,E	1	
<u>SMALL TO MEDIUM-SIZED RIVERS</u>				
Bear Creek #1				
SCH99-070	16	B,E		
SCH99-071	8	B,E		
Bear Creek #2				
SCH99-123	17	B,E		

<u>Site</u>	<u># Taxa</u>	<u>Habitat</u>	<u>New County Records</u>	<u>Notes</u>
Cedar Creek				
SCH99-073	10-11	B,E		
Hatton Creek				
SCH99-086	23	B,E	1	
Maple Creek				
SCH99-074	8	B,E		
SCH99-075	23	B,E	1	
SCH99-076	10	B	1	
Pigeon River				
SCH99-095	22	B,E	1	
Shioc River				
SCH99-064	34	B,E	2	lentic shoreline area
SCH99-065	6	B		
SCH99-109	24	B		
Walla Walla Creek				
SCH99-083	29	B,E		
SCH99-087	17	B,E	3	
unnamed creeks				
SCH99-054	22	A,B,C,E	1	
SCH99-056	18	A,E		
SCH99-057	14	B,E		
SCH99-061	12	B	1	
SCH99-072	11	B,E		
<u>FLOWAGES</u>				
SCH99-103	20(net) 13(bottles) 27(total)		3	
SCH99-108	23(net) 23(bottles) 39(total)		6	Pikes Peak Flowage 80-Acre Flowage Wolf River Flowage Wolf River Flowage Wolf River Bottoms Wolf River Bottoms
SCH99-111	31(net)			
SCH99-112	20(net)			
SCH99-113	17(net)			
SCH99-115	37(net)		5	
SCH99-116	23(net)		2	
<u>SHALLOW MARSHES</u>				
SCH99-104	22(net) 15(bottles) 31(total)			Shioc Mitigation Site McDonald Marsh
SCH99-110	25(net) 18(bottles) 36(total)		5	
<u>SWAMPS</u>				
SCH99-105	38(net)		3	Maine W.A. (swamp)
SCH99-114	17(net)		1	Deer Cr. W.A.

<u>Site</u>	<u># Taxa</u>	<u>Habitat</u>	<u>New County Records</u>	<u>Notes</u>
<u>BOGS</u>				
SCH99-101	27(net) 23(bottles) 40(total)		6	Hortonville Bog
SCH99-106	32(net) 32(bottles) 53(total)		10	Maine W.A. (bog)
SCH99-107	19(net) 10(bottles) 26(total)		11	Navarino Bog
<u>SPRINGS</u>				
SCH99-102	6(net)		1	artesian spring outlet
SCH99-102	32(net)		7	spring pond area
<u>SLOUGHS</u>				
SCH99-062	25(net)		2	slough to Wolf River
SCH99-081	28(net)		2	Colic Bayou
<u>LAKES</u>				
SCH99-099	22(net)			White Clay Lake
SCH99-127	22(net)			White Lake

Rare Species

The following species were collected during this study and are considered rare in the state. These species should be added or considered for addition the WI NHI Working List.

COLEOPTERA

Hydrophilidae

Cymbiodyta minima Notman

Uncommon statewide. Known from 201 specimens from 32 sites, but 131 of these are one site. Found in shallow lentic habitats and margins of streams.

Enochrus collinus Brown

Rare statewide. Known from 15 specimens and 11 populations. Found in ponds, marshes, and 1 from a bog.

Enochrus consortus Green

Uncommon southern 1/3 of the state, rare elsewhere. 210 specimens from an estimated 24 populations. Found in ponds, marshes, margins of lakes and streams.

Enochrus sayi Gundersen

Uncommon in southern half of the state (Pierce to Shawano counties) and absent in the northern half. 266 specimens known from at least 15 populations. Known from ponds. Most have been collected at blacklight traps.

Helocombus bifidus (LeConte)

Uncommon statewide with 51 specimens from at least 33 populations. Found in shallow lentic habitats. Most records were single specimen collections, and so is rare even when found.

Laccobius agilis (Randall)

Rare to uncommon statewide. 28 specimens known from at least 16 populations. Found in ponds, spring ponds, seeps, and margins of streams.

Laccobius reflexipennis Cheary

Marathon and Menominee counties. 2 specimens from 2 populations. Found in margins of streams and ponds.

Sperchopsis tessellata (Ziegler)

Rare in western $\frac{3}{4}$ of state (Florence to Dane counties), not recorded from eastern $\frac{1}{4}$. 26 specimens from over 20 sites. Found in small, cool streams, usually with sand.

Cymbiodyta acuminata Fall

Fairly common in northern $\frac{2}{3}$ of state and uncommon in southern $\frac{1}{3}$. 115 specimens known from at least 23 sites. Found in shallow lentic habitats.

Hydrochara leechi Smetana

One adult was collected from site SCH99-105, a swamp in the Maine Wildlife Area close to the main access road. The specimen was collected in a bottle trap. This species is represented in the state by only 3 known specimens collected in Dane Co. in 1915 and 1916; it has not been collected in 83 years (Hilsenhoff 1995). The specimen was a female, which are more difficult to identify than males, but it was verified by Dr. Hilsenhoff. A total of 97 specimens and 4 species of *Hydrochara* were collected in the 2 bottle traps, but only 1 specimen of *H. leechi* was found.

Laccobius reflexipennis Cheary

One adult was collected from Walla Walla Cr. (SCH99-087). Less than 6 specimens were previously known from the state, and only 3 previous county records (Hilsenhoff 1995).

Dytiscidae

Agabus bicolor (Kirby)

Fairly common in northern $\frac{1}{3}$ of Wisconsin (Burnett to Marinette counties), rare elsewhere. 64 specimens found in 20-60 populations. Found primarily in black spruce-tamarack swamps with a few in sedge-cattail marshes and shallow ponds.

Agabus inscriptus (Crotch)

Rare to uncommon statewide. 47 specimens known from at least 15 populations. Most were collected from habitats with Sphagnum.

Celina hubbelli Young

Uncommon south of a line from St. Croix to Sheboygan counties, absent elsewhere. 54 specimens found from at least 13 populations. Known in shallow cattail habitats, where oxygen can be obtained from cattails.

Hydroporus badiellus Fall

Common in northern $\frac{1}{3}$ of state (Polk to Marinette counties) but rare elsewhere. 200 specimens known from 20 to 100 populations. Located in habitats containing Sphagnum.

Ilybius discedens Sharp

Common in northern $\frac{1}{3}$ of state (Polk to Marinette counties), rare elsewhere. 141 specimens found in 20-100 populations. Known in habitats containing Sphagnum.

Ilybius ignarus (LeConte)

Uncommon throughout state

Graphoderus manitobensis Wallis

Uncommon south of a line from Pepin to Manitowoc counties, absent elsewhere. 63 specimens known from at least 10 populations. Found in large sedge and cattail marshes.

Liodessus cantralli (Young)

Three adults were collected in bottle traps from SCH99-106 (Maine Wildlife Area bog). Only 3 specimens had been previously collected in the state from 2 counties (Hilsenhoff 1994).

Lioporeus triangularis (Fall)

One adult was collected on submerged wood from the shoreline of the Wolf River in New London (SCH99-077). It was previously known from only 3 counties in the state, and by only 10 specimens (approximately).

Matus bicarinatus (Say)

Eight specimens were collected from an artesian spring and spring pond (SCH99-102), and 1 from the Shioc River (SCH99-064). Although this species occurs in several counties in the southern third of the state, it is relatively rare and the 9 specimens collected in this study represent the most northern collection of this species in the state (Hilsenhoff 1993).

Neoporus vittatus (LeConte)

Uncommon statewide. 78 specimens known from at least 34 populations. Most were located in small to medium stream habitats. Also adjacent to ponds and spring ponds.

Neoscutopterus hornii (Crotch)

This species is fairly common in the northern third of Wisconsin, but it is rare in the central portion of the state, and absent in the southern third (Hilsenhoff 1993). One specimen was collected from the Hortonville Bog (SCH99-101) with a net, and it likely represents the most southern distribution record for the state. This species is found only in black spruce-tamarack swamps that contain *Sphagnum*.

Rhantus sinuatus (LeConte)

Uncommon statewide. 76 specimens found in at least 24 populations. Located mostly in shallow sedge or cattail marshes, often with sphagnum. Almost all were collected in bottle traps, suggesting nocturnal species.

Elmidae

Dubiraphia bivittata (LeConte)

Uncommon south of a line from La Crosse to Outagamie counties. Rare in Burnett and Vilas counties, apparently absent elsewhere. 106 specimens found in at least 21 populations. Found in plants and submerged wood in medium to large rivers and adjacent sloughs, marshes and ponds.

Stenelmis antennalis Sanderson

Common in Burnett Co., rare to locally common in central WI, and absent elsewhere. 395 specimens known from at least 13 populations. Found in submerged wood, largely sandy rivers.

Stenelmis bicarinata LeConte

Common in northwest Wisconsin, rare in northern half (Buffalo to Outagamie counties), absent in southern half. 469 known specimens from at least 32 populations. Found in submerged wood and large sandy rivers.

Stenelmis fuscata Blatchley

Rare along a linear distribution from Iowa to Oconto counties. 138 specimens known from at least 11 populations. Found in submerged wood and large sandy rivers.

Halipidae

Halipus pantherinus Aube

Uncommon throughout the state. 47 specimens found from at least 10 populations. Located in lakes, ponds, and stream margins.

Halipus canadensis Wallis

Uncommon in eastern 1/3 of state, absent elsewhere. 43 specimens found in at least 10 populations. Located in lentic habitats.

HETEROPTERA:

Corixidae

Hesperocorixa semilucida (Walley)

Uncommon south of a line from Trempealeau to Shawano counties, absent elsewhere. 45 specimens found in at least 21 populations. Located in ponds in the spring and larger rivers to overwinter.

Hebridae

Hebrus burmeisteri Lethierry & Severin

Rare statewide, apparently absent in the Northwest. Distribution could be misleading because of its very small size leading to sampling bias. 28 specimens found in at least 14 populations. Known in shallow lentic habitats.

Hydrometridae

Hydrometra martini

Located statewide. 61 specimens found in at least 19 populations. Found in ponds, sloughs, and other lentic sites.

Naucoridae

Pelocoris femoratus (Palisot de Beauvois)

Four specimens were collected from Shawano County in the Wolf River (SCH99-097) and an unnamed tributary to the Wolf River (SCH99-061). This species of creeping water bug is uncommon to rare in southern Wisconsin, and Shawano Co. represents the most northern record of the species (Hilsenhoff 1984).

Nepidae

Ranatra nigra Herrich-Schaffer

Rare in south of Lincoln Co, apparently absent in north. 52 specimens from 13 collections. Found in large, deep lentic sites and rivers.

EPHEMEROPTERA:

Baetidae

Plauditus cestus

Found in Barren and Dunn counties. 12 specimens found in at least 10 populations. Located on Turtle Creek. Hilsenhoff has other unpublished records.

Baetiscidae

Baetisca obesa (Say)

Rare, known only from Wisconsin River, (Columbia Co and south) and St. Croix River. 55 specimens known from 18 populations. Located in large sand-bottomed rivers

Pseudironidae

Pseudiron centralis McDunnough

This relatively rare species is known from several large, sand-bottomed rivers throughout the state, although mainly western and southern in distribution. It was previously collected from the lower Wolf River watershed in the Embarrass River at Behnke Road in Waupaca County (Lillie 1995). During the current study, *Pseudiron* was found at 1 site on the Wolf River (SCH99-063, Hwy 156) and 3 new sites on the Embarrass River (SCH99-118: Hwy 156, SCH99-120: Hwy I, SCH99-121: Hwy XX). Fairly large to large populations occurred at all 4 sites. Larvae occurred in shallow (6 inches) to deep (4 feet) water on shifting sand bars. Larvae could be detected by eye in the shallow water, but their cryptic coloration made them camouflaged against the sand background. Several specimens were observed for 15 minutes resting and scurrying along the sand.

Diptera: Chironomidae

Axarus

One larva of this genus of chironomid was collected from the Embarrass River (SCH99-119). I am aware of only one other specimen collected from the state (Manitowoc Co.).

ODONATA:

Corduliidae

Neurocordulia yamaskanensis Provancher

A total of four exuviae were found at three sites: Little Wolf River (SCH99-091, -126) and Wolf River (SCH99-079). No larvae of this large corduliid were collected.

Gomphidae

Ophiogomphus howei Bromley

Many specimens (mostly exuviae) were collected from the Embarrass River (SCH99-096, -100 & -117), Little Wolf River (SCH99-080, -093 & -094), and the Wolf River (SCH99-053, -060 & -098). Its range extended from the city of Shawano to River Road boat landing on the Wolf River, from Ridge Line Road to Behnke Road on the Embarrass River, and from Kretchner Road to County Highway X on the Little Wolf River.

Stylurus notatus (Rambur)

A total of 13 larval specimens and 1 exuvia of this species were collected from 3 rivers: Embarrass (SCH99-122, -124, -125), Wolf River (SCH99-058, -066), and the Waupaca River (SCH99-082).

PLECOPTERA:

Perlodidae

Isoperla bilineata (Say)

Common in western and southwest WI, rare or absent elsewhere. At least 360 specimens known from up to 100 populations. Found in large rivers.

Isoperla marlynia Needham & Claassen

Uncommon in northern 1/3 of state, rare in Juneau, Crawford, and Green counties, apparently absent elsewhere. At least 25 specimens found from at least 13 populations. Located in large rivers.

Isoperla richardsoni Frison

Uncommon in northern half of state, absent in southern third and extreme north. At least 175 specimens found from 20-100 populations. Found in large rivers.

TRICHOPTERA:

Hydropsychidae

Hydropsyche bidens Ross

Uncommon in lower Wisconsin, Chippewa, St. Croix, Wolf Rivers, absent elsewhere. 91 specimens found from at least 11 populations. Located in submerged wood in large sandy rivers.

New State Records

The following taxa were collected during this study and represent new records for Wisconsin.

Trichoptera: Leptoceridae

A. *Oecetis nocturna* Ross (2 larval specimens)

B. *Oecetis* near sp. A (Floyd 1995) (1 larval specimen)

C. *Trienodes flavescens* Banks (1 larval specimen)

D. *Trienodes nox* Ross (1 larval specimen)

All four species of these caddisflies were expected to occur in Wisconsin based on their U.S. distributions (Floyd 1995, Glover 1996). As a matter of fact, larval specimens may already exist in the University of Wisconsin's Insect Research Collection (UWIRC). However, the recent larval keys by Floyd (1995) and Glover (1996) have not yet been used to identify the specimens of these two genera that are housed in the UWIRC.

Diptera: Chironomidae

A. *Omisus* (1 larval specimen)

B. *Zavreliella marmorata* (Wulp) (2 larval specimens)

These specimens were collected from Pikes Peak Flowage (SCH99-108). Both taxa were expected to occur in Wisconsin.

Oligochaeta: Naididae

Dero vaga (Leidy) (3 specimens)

This species was collected from Pikes Peak Flowage (SCH99-108) and Wolf River Bottoms W.A. (SCH99-115); it was expected to occur in Wisconsin.

Conchostraca

Lycneus brachyurus Muller

Many specimens of this species of clam shrimp were collected in McDonald Flowage (SCH99-110) and Deer Creek Wildlife Area (SCH99-114). No published records of this species in Wisconsin could be found, but the species was expected to occur in the state.

Notable Sites

Large Rivers.

Without question, the most important water bodies within the lower Wolf River Watershed with regard to abundance and diversity of aquatic macroinvertebrates are the large rivers: Wolf, Little Wolf, South Branch, Embarrass, and Waupaca. A minimum taxa richness value of at least 38 was observed in each of

the rivers, and a maximum value of at least 80 was observed in the Wolf River at Highway 29 (SCH99-053). These values are obviously conservative estimates because

- 1) some taxa could not be identified to the species level;
- 2) some taxa had already emerged and were not present as larvae (brachycentrid caddisflies –cases were observed);
- 3) some taxa were likely present only as eggs or very immature and unidentifiable larvae;
- 4) some taxa were missed by the collecting efforts and techniques;
- 5) some taxa were not targeted (many small midge larvae and worms)

These water bodies also provided many records of rare species and new county records, as mentioned above.

Small to Medium-Sized Rivers

Some of the small to medium-sized rivers provided habitat for species that inhabit smaller, colder-water streams (e.g. *Cordulegaster maculata*). In particular, the unnamed streams SCH99-056 and SCH99-061 that empty directly into the Wolf River were notable streams because of their good water quality and contrasting habitat compared to the large Wolf River. On the other hand, unnamed stream SCH99-057 and Bear Creek (SCH99-123) were notable because of their poor water quality and lack of abundant and diverse stream-dwelling species.

Flowages, Sloughs, Swamps, and Shallow Marshes

Most of these types of water bodies had large numbers of macroinvertebrates with relatively high diversity. In general, the macroinvertebrate communities in these habitats could be summarized as being dominated by very common, “weedy” species; species that are abundant throughout the state and are quick to colonize new bodies of water and areas that have been disturbed.

Notable exceptions include Pikes Peak Flowage (SCH99-108), Wolf River Bottom-K&S Unit site SCH99-115, McDonald Marsh (SCH99-110), and the swamp at the Maine Wildlife Area (SCH99-105). These sites contained several new county records, and/or new state records, and had the highest values for taxa richness. As was stated above, the taxa richness values underestimate the true diversity that occurs at these sites. In particular, the aquatic and semi-aquatic Heteroptera and Coleoptera were undoubtedly underrepresented because of the early spring or late-summer life cycles exhibited by many species.

Bogs and Springs

These habitats were rare in the Wolf River Watershed. Consequently, the macroinvertebrate communities within these sites yielded many rare species and new county records. All three bogs that were sampled (Hortonville Bog SNA, Maine and Navarino wildlife areas) had high values (26-53) of taxa richness, along with the single spring pond that was sampled (32).

Lakes

The two lakes that were sampled were marl lakes. Taxa richness was moderate for both lakes, and the communities were composed of relatively common species. However, due to the soft sediments, the difficulty in reaching sites away from the public boat landings, and the differing life cycles of lentic species (Heteroptera, Coleoptera) mentioned above, taxa richness values for these two lakes were very conservative.

Considerations For Management And Protection

Large Rivers

Without a doubt, the large rivers in the lower Wolf River Watershed are the most important bodies of water for the aquatic macroinvertebrate communities, and each river should be considered during any management and protective activities. There are at least three critical characteristics of the large rivers that promote species abundance and diversity:

1. good water quality
2. consistent and proper flow
3. substrate diversity

Good shoreline development practices will address all three characteristics. Proper sewage treatment, agricultural practices, and riparian vegetation and structures will assist in protecting water quality.

Substrate diversity is especially noticeable in the Wolf River where substrates vary from rocky bottom, to sand/gravel bottom, to shifting sand bottom, to mostly clay and silt. Submerged wood is vitally important in all streams, but particularly in larger rivers where substrate diversity is lacking and shifting sand bottoms or clay bottoms are prevalent. In most cases, submerged wood is the only substrate in sections of a river where large numbers and high diversity of aquatic macroinvertebrates will occur. Removing submerged wood or preventing large wood from entering a river system should be considered detrimental to a healthy aquatic macroinvertebrate community. Also vitally important in both the Wolf and Embarrass rivers are the areas of shifting sand and sand bars. These areas are colonized by the rare mayfly *Pseudiron centralis*, its prey, and possibly other rare species that were not found during this study. These large, open, sandy areas are often considered deserts because of the perceived scarcity of organisms (abundance and diversity) due to the apparent lack of suitable substrates for colonization. On the contrary, these areas can harbor large populations of specialized species that have adapted to living on shifting sand. These areas must be protected from siltation and destructive flows, including minimal flows that will allow sand bars to become exposed, heavy flows that will move large amounts of sand downstream, or flows that will in anyway narrow the channel and reduce the amount of surface area of the substrate.

Small to Medium-Sized Streams

These streams are more easily disturbed than the large rivers. Although some of these streams appear to be good shape, others are clearly in questionable or poor condition, such as both Bear creeks, portions of Maple Creek, the Shioc River, and unnamed creeks SCH99-054, -057 and -072. Water quality studies should occur on these streams.

Shallow Marshes

The two shallow marshes that were sampled for aquatic macroinvertebrates (Shioc Mitigation Site, McDonald Marsh) were quite productive, exhibiting high abundance and diversity, even though many of the taxa were common, “weedy” species. It is likely that the high abundance and diversity can be attributed to the shallow water, dense vegetation, and relative lack of vertebrate predators (fish). All three characteristics promote the occurrence of large, soft-bodied and sedentary species (odonates), and species that are atmospheric breathers, which must come to the surface to obtain oxygen. Rising to the surface to obtain oxygen makes the adults and some of the larvae very visible and prone to predation. Maintaining these marshes with shallow water and dense vegetation will likely continue to promote species abundance and diversity, provided that fish populations (sticklebacks, mudminnows, catfish, and others) do not explode.

Bogs and Springs

Since all of the bogs that were sampled harbored rare to uncommon, bog-inhabiting species, and because bogs are uncommon for this portion of the state, it is recommended that all of the bogs be protected from disturbance. It is also recommended that the single artesian well that was sampled (SCH99-102) be protected, as well as the spring pond downstream. The artesian well can either be left alone, or reconstructed to provide more natural habitat.

Future Inventory

Additional sites and habitats should be sampled, along with the re-sampling of some sites. Prioritizing sites and habitats should be done in cooperation with pertinent project personnel who have knowledge and concerns about these sites and habitats. This should occur after initial reports have been studied and workshops have been attended.

Earlier sampling is advised to collect species that emerge in late winter/early spring and were missed during the current study. Also, later sampling should be considered to collect late summer/early fall species.

Sampling of inaccessible sites along the Wolf River and Embarrass River should occur. These sites can be accessed by boat.

Sampling lentic sites by using submerged bottle traps should be expanded. More bottle traps at each site can be done.

Literature Cited

- Floyd, M.A. 1995. Larvae of the caddisfly genus *Oecetis* (Trichoptera: Leptoceridae) in North America. Bulletin of the Ohio Biological Survey, New Series 10(3).
- Glover, J.B. 1996. Larvae of the caddisfly genera *Triaenodes* and *Ylodes* (Trichoptera: Leptoceridae) in North America. Bulletin of the Ohio Biological Survey, New Series 11(2).
- Hilsenhoff, W.L. 1993. Dytiscidae and Noteridae of Wisconsin (Coleoptera). III. Distribution, habitat, life cycle, and identification of species of Colymbetinae, except Agabini. Great Lakes Entomologist 26: 121-136.
- Hilsenhoff, W.L. 1993. Dytiscidae and Noteridae of Wisconsin (Coleoptera). V. Distribution, habitat, life cycle, and identification of species of Hydroporinae, except *Hydroporus* Clairville sensu lato. Great Lakes Entomologist 26: 275-295.
- Hilsenhoff, W.L. 1995. Aquatic Hydrophilidae and Hydraenidae of Wisconsin (Coleoptera). II. Distribution, habitat, life cycle and identification of species of Hydrobiini and Hydrophilini. Great Lakes Entomologist 28: 97-126.
- Lillie, R.A. 1995. A survey of rare and endangered mayflies of selected rivers of Wisconsin. Wisconsin DNR, Research Report 170.